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Assessing the Constraints of COVID-19 Pandemic on Vegetable Growers: A Comprehensive Analysis

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Abstract

The onset of the COVID-19 pandemic raised major concerns for the agricultural sector, particularly for vegetable growers who are highly vulnerable due to the perishable nature of vegetables and reliance on labour-intensive operations that rely mainly on labour-driven operational practices. The research aims to provide a comprehensive analysis of the constraints vegetable growers face due to the COVID-19 Pandemic. Using an ex-post facto research design, we analysed the cause-and-effect relationship between variables among 240 vegetable growers from two districts and eight villages in Odisha, India. The findings reveal that fear of COVID-19 infection with an average garret score of 73.11 is impacting their willingness to work and interact, Restrictions on movement and social gatherings due to lockdown with an average garret score of 72.91 hindered farming operations, high cost of labour and agricultural inputs with an average garret score of 72.02 driven by reduced availability and increased demand, shortage of labour with an average garret score of 71.02, inadequate knowledge and awareness on COVID-19 pandemic with an average garret score of 70.25 and lack of transportation facilities due to mobility restrictions with an average Garrett score of 72.07 are some of the critical constraints faced by vegetable growers. The research findings have several implications for policy or practice to mitigate future disruptions and enhance the resilience of the agricultural sector.

Keywords

COVID-19; Constraints; Agricultural resilience; Vegetable growers

Introduction

The COVID-19 pandemic had emerged as a health crisis of unprecedented scale and complexity which had multifaceted impacts on various aspects of the global society. It had far-reaching consequences across every sector with agriculture being no exception. As one of the hardest-hit industries, agriculture faced

significant challenges due to the pandemic. Agriculture, the backbone of India's economy, contributes 33% of the country's horticultural output, with a significant share coming from vegetables. India is one of the leading producers of vegetables in the world and ranks second after China (MoAFW, 2020). Vegetable cultivation plays a critical role in Indian agriculture, contributing substantially to the food supply chain, enhancing food security and nutrition, and supporting local economies through employment and income generation. The outbreak of the pandemic triggered a series of constraints that affected their ability to produce, distribute and market their produce effectively. It triggered a cascade of disruptions across supply chains, labour shortages and market access significantly impacting the operations of the vegetable farming system (Arumugam, Kanagavalli and Manida, 2020). These challenges not only, strained their daily operations but also highlighted the vulnerabilities within vegetable farming threatening the livelihoods of vegetable growers. The pandemic started when farmers were ready to harvest and sell their Rabi crops and its impact continued into the subsequent Kharif season. As a result, farmers faced significant challenges in harvesting their produce, marketing it, and securing essential agricultural inputs for the next planting season (NABARD, 2020). During the early stages of the pandemic, the imposition of lockdowns, travel restrictions, quarantine measures and health concerns severely disrupted the agricultural workforce, further exacerbating the challenges faced by farmers and hindering the overall agricultural production cycle. Many urban workers who had lost their jobs and migrant workers from abroad returned home to their rural villages creating a labour surplus. At the same time, would-be migrant workers were restricted from traveling to village communities creating labour shortages (Kabir, Maple and Usher, 2021; Karim, Islam and Talukder, 2020; Kumar *et al*., 2021). Vegetable farming often relies heavily on seasonal and migrant workers essential for planting, cultivating and harvesting crops. These labour shortages have not only delayed essential farming operations but also increased labour costs and operational inefficiencies (Bansal and Pande, 2020). Furthermore, in addition to labour shortages the pandemic had triggered widespread disruptions in agricultural supply chains. The virus wreaked havoc on the agricultural production sector which is at the heart of the food chain (Pu and Zhong, 2020). The agricultural supply chains were severely disrupted due to lockdowns, transportation restrictions, disruptions in distribution networks and manufacturing slowdowns. These interruptions resulted in shortages and delays in the availability of essential production inputs such as farm machinery, fertilizers, seeds and pesticides. The vegetable growers were adversely affected as they heavily depended on the timely supply of these inputs. The resultant supply chain issues also led to increased costs of inputs and uncertainty in their availability, impeding producers' ability to manage production and meet market demands (MoAFW, 2020). The pandemic also had a dramatic impact on market access and reduced demand for vegetable growers. The limitations on consumers' movement and market access coupled with the shutting down of food service establishments such as hotels, cafeterias and restaurants resulted in a sharp decline in the demand for fresh vegetables (FAO, 2020). Farmers faced serious financial challenges as a result of declining product demand, supply disruptions and being forced to sell below cost (Termeer, Brouwer and de Boef, 2020). With reduced demand and restrictions on selling farm produce, many vegetable growers faced financial strain due to the unsold surplus coupled with price volatility. However, the pandemic introduced a range of constraints that disrupted every facet of vegetable farming. The immediate and cascading effects of these disruptions highlight the need for a deeper understanding of the impact on agricultural practices and

food systems. This assessment is essential for evaluating the broader implications of agricultural sustainability and resilience, emphasizing the importance of developing adaptive strategies to safeguard the future of farming.

Material and Methods

Study Area

The study was administered in the state of Odisha, India. It is the eighth largest state in terms of area with a total area of 155,707 km^2 constituting about 4.87% of the country. Odisha is located between the latitudes 17.780N and 22.730N and longitudes 81.37E and 87.53E along with a coastline of 450 km in the eastern part of India. It is an agrarian state with a total cultivated area of about 61.50 lakh hectares and the majority of the population depends on agriculture for their livelihood. Odisha ranks seventh in terms of vegetable production with a share of 4.7% among the major vegetable-producing states of the country. It comprises 10 agro-climatic zones out of which two agro-climatic zones North Eastern Coastal Plain and East and South Eastern Coastal Plain with high potential for vegetable production were selected.

Selection of Sample Sites

From the agro-climatic zones in the area, Balasore (North Eastern Coastal Plain and Cuttack (East and South Eastern Coastal Plain) districts were purposively selected based on the highest Gross cropped Area (GCA) (Odisha Agriculture Statistics 2018-2019) which refers to the maximum total area of the districts under vegetable cultivation as compared the other districts across the region. Apart from those two blocks from each district and a two-gram panchayat from each block followed by two villages from each gram panchayat were randomly selected for the study. An ex-post facto research design was used to investigate the relationships between variables. A total of 240 vegetable growers were selected through proportionate random sampling for the study by covering 2 districts of 4 blocks and 8 villages of Odisha.

Data Collection and Analysis

Data was collected from primary and secondary sources. Primary data was obtained through personal interviews with the vegetable growers using a structured interview schedule along with focused group discussions. The personal interview Involves one-on-one interaction with the vegetable growers to understand their personal views while the focused group discussions constitute a group of vegetable growers which encourages interaction among the participants for discussing the set of issues which are useful for understanding their collective perspectives and group dynamics. The collected data identified and categorized various constraints faced by vegetable growers into six key areas: psychological constraints, social constraints, economic constraints, production constraints, technological constraints, and marketing constraints. Each category highlighted specific challenges that impacted the growers' ability to sustain and manage their farming operations effectively during the pandemic.

Further, Garrett's Ranking Technique was used for analysis where the vegetable growers were asked to assign a rank to the constraints of each category according to its degree of severity from their point of view. Thereafter, the individual rank given by the vegetable growers was converted into per cent position by using the formula:

$$\text{Percent position} = 100\left(\frac{Rij-0.5}{Nj}\right)$$

Where R_{ij} = Rank given to the i^{th} variable by the j^{th} individual
N_j = Number of variables ranked by the j^{th} individual.

The per cent position formula consists of two components such as R_{ij} which is the rank given to the i^{th} variable by the j^{th} individual and N_j which is the number of variables ranked by the j^{th} individual. Further, the per cent position calculations for each rank were thereby converted into scores by using Garrett's table given by Garret and Woodwoth (1969). The value of the Average Garret score for each constraint was obtained by adding together the scores of the individual vegetable growers divided by the total number of vegetable growers for whom the scores were added. Thus, the Average Garret score for each constraint was obtained and a rank was assigned accordingly identifying the significant constraints affecting the vegetable growers.

Results and Discussion

The pandemic exposed several critical issues that significantly disrupted the farming practices of vegetable growers. The findings of the study provide an overview of the various dimensions of constraints perceived by the growers, categorized as follows: Psychological Constraints, Social Constraints, Economic Constraints, Production Constraints, Technological Constraints and Marketing Constraints.

Psychological Constraints

The various psychological constraints are presented in table 1.

Table 1: Distribution of Respondents According to the Psychological Constraints

Sl.No.	*Constraints*	*Rank given by the vegetable growers*								*Average Garret score*	*Rank*
		R1	*R2*	*R3*	*R4*	*R5*	*R6*	*R7*	*R8*		
1.	Fear of socialization	5	183	15	11	6	10	8	2	63.70	II
2.	Increase in anxiety and depression	12	18	10	154	8	11	14	13	51.91	IV
3.	Fear of COVID-19 infection	192	5	8	10	7	6	3	9	73.11	I
4.	Insomnia, stress and nervousness	4	3	6	12	39	137	23	16	38.97	VI
5.	Fear of loss of livelihood	5	6	168	11	14	12	9	15	54.28	III
6.	Fear of theft and insecurity	7	9	13	10	142	16	24	19	45.54	V
7.	The feeling of restlessness and frustration	10	15	19	8	14	20	36	118	34.72	VIII
8.	Fear of social stigma	8	5	9	12	18	33	130	25	37.38	VII

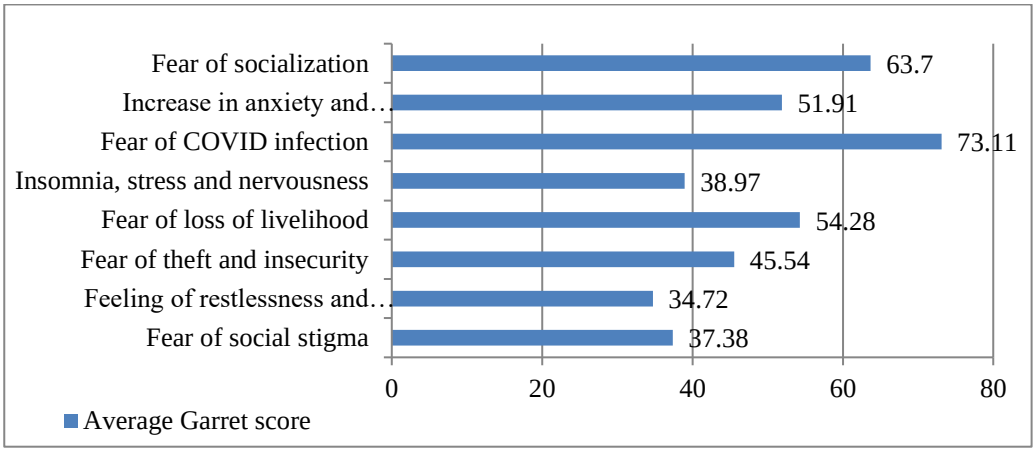

Figure 1: Psychological Factors Impacting Vegetable Growers

Fear of COVID-19 infection ranked as the most critical psychological constraint (Garrett score: 73.11, Rank I) (Figure 1) due to the unpredictable nature of viral transmission. The fear of socialization ranks second with a score of 63.70, followed by the fear of loss of livelihood at third with a score of 54.28, underscoring the importance of economic stability. Anxiety and depression increase, ranking fourth with a score of 51.91, while fear of theft and insecurity ranks fifth at 45.54. Other notable constraints include insomnia, stress, and nervousness (ranked sixth, 38.97), and fear of social stigma (seventh, 37.38). Lastly, feelings of restlessness and frustration are ranked eighth with a score of 34.72. These findings illustrate a range of psychological challenges, indicating the need for targeted mental health interventions. These psychological challenges likely stem from the widespread havoc caused by the pandemic, compounded by stringent measures such as social distancing and isolation, which significantly affected the growers' mindset and cognitive abilities. It acted as the mental and emotional barriers affecting their livelihood and critically hindering their decision-making abilities to manage farms along with the adoption of coping strategies to the changing circumstances. These findings align with those of Serafini *et al*. (2020), where the vegetable growers are prone to severe mental health risks and economic hardship, which also highlighted the detrimental psychological impact of the pandemic on individuals across various sectors.

Social Constraints

The study identified various social constraints faced by vegetable growers during the pandemic, as outlined in table 2. The constraints were ranked based on their average Garrett scores, indicating their severity**.**

According to figure 2, the most significant social constraint was restrictions on movement and social gatherings due to the lockdown, with an average score of 72.91, ranked first. This was attributed to the severe health risks associated with COVID-19 transmission. Low social or personal interactions ranked II, with a score of 61.38, highlighting the impact of reduced community engagement on farmers. Social distancing and quarantine protocols were ranked III, with an average score of 54.64, further limiting social and communal activities. Reverse migration of farm families ranked IV, with a

score of 48.90, reflecting the disruption caused by the return of migrant workers to rural areas. Lack of support and cooperation from neighbours and villagers ranked V, scoring 41.68, indicating weakened community ties during the pandemic. Limitations in various farming activities ranked VI, with an average score of 40.94, as lockdown measures hindered collaborative farming efforts. Restrictions in the accessibility to resources ranked VII, with a score of 34.34, underscoring the difficulty in obtaining essential inputs and services. These social constraints primarily arose due to the highly contagious nature of COVID-19, prompting the implementation of strict measures to minimize human interaction and control the virus's spread. They had far-reaching compounding effects on the psychological, economic and operational difficulties exacerbating the challenges faced by the vegetable growers. These social constraints can be addressed by strengthening community networks, improving access to resources and ensuring efficient agricultural support systems.

Table 2: Distribution of Respondents According to the Social Constraints

Sl.No.	*Constraints*	*Rank given by the vegetable growers*							*Average Garret score*	*Rank*
		R1	*R2*	*R3*	*R4*	*R5*	*R6*	*R7*		
1.	Social distancing and quarantine protocols	5	17	173	12	15	11	7	54.64	III
2.	Limitations in various farming activities	15	12	14	20	23	140	16	40.94	VI
3.	Low social or personal interactions	8	187	13	10	6	9	7	61.38	II
4.	Lack of support & cooperation from neighbours and villagers	10	7	8	14	147	21	33	41.68	V
5.	Restrictions in accessibility to resources	13	11	6	25	21	36	128	34.34	VII
6.	Restrictions on movement and social gatherings due to lockdown	196	12	9	7	6	8	2	72.91	I
7.	Reverse migration of farm families	7	17	14	161	9	13	19	48.90	IV

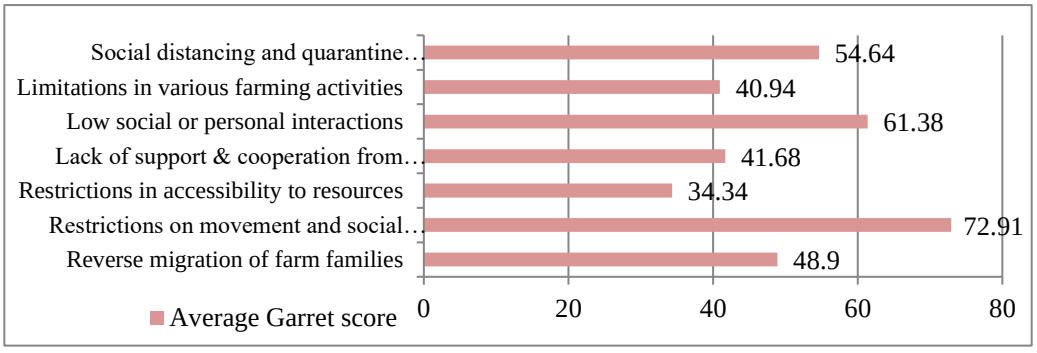

Figure 2: Social Constraints Impacting Vegetable Growers

Economic Constraints

The economic constraints are presented in table 3.

Table 3 Distribution of respondents according to the Economic Constraints

Sl.No.	*Constraints*	*Rank given by the vegetable growers*							*Average Garret score*	*Rank*
		R1	*R2*	*R3*	*R4*	*R5*	*R6*	*R7*		
1.	Drastic fall in farm income	7	19	15	159	9	13	18	49.17	IV
2.	High cost of labour and agricultural inputs	195	9	6	7	8	11	4	72.02	I
3.	Lack of regulated price policies	10	7	12	18	135	21	37	41.73	V
4.	High expenditure and indebtedness	8	15	9	21	33	41	113	35.11	VII
5.	Lack of awareness of financial assistance	14	12	24	20	18	123	29	40.90	VI
6.	Inaccessibility to credit and banking facilities	9	180	14	11	6	12	8	60.77	II
7.	Low cost of the farm produce in the market	8	10	166	13	17	12	14	53.40	III

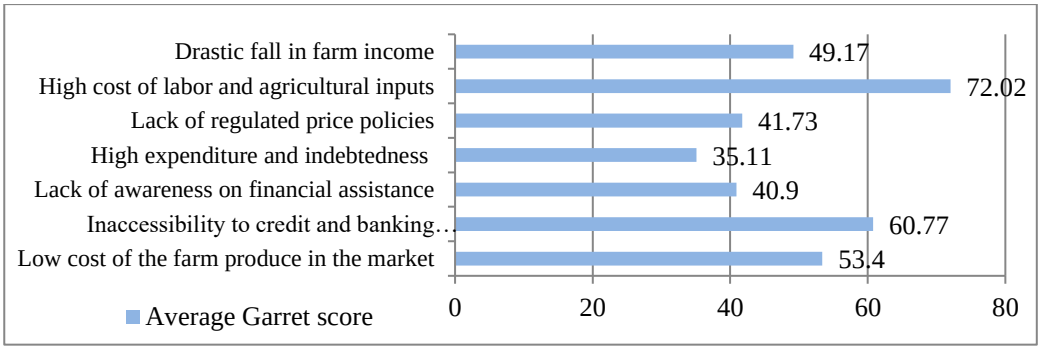

Figure 3: Economic Constraints Impacting Vegetable Growers

Figure 3 indicates that the high cost of labour and agricultural inputs is the most significant economic constraint, exhibiting an average Garrett score of 72.02, thereby ranking it first. This may be due to the imbalance in the demand and supply of agricultural goods and services affecting vegetable growers followed by inaccessibility to credit and banking facilities with an average garret score of 60.77 being ranked-II and low cost of the farm produce in the market with an average garret score of 53.40 being ranked-III were put first, second and third in order of priority respectively. The economic constraints ranked as least important include: a drastic fall in farm income at rank IV, a lack of regulated price policies at rank V, a lack of awareness about financial assistance at rank VI, and high expenditure and indebtedness at rank VII. These constraints have average Garret scores of 49.17, 41.73, 40.90, and 35.11, respectively. These constraints had severely affected the efficient management of farm costs impacting the financial stability of vegetable growers. This may be because the pandemic had endangered the livelihoods of vegetable growers leading to economic shock thereby making them more

vulnerable to economic insecurity. Similar findings were obtained by Middendorf *et al.* (2021) and Kulkarni *et al.* (2022) where it was emphasized that disparities in financial security, resources and infrastructure facilities contextualize these issues challenging the vegetable growers.

Production Constraints

The various production constraints faced are presented in table 4.

Table 4: Distribution of Respondents According to the Production Constraints

Sl.No.	*Constraints*	*Rank given by the vegetable growers*						*Average Garret score*	*Rank*
		R1	*R2*	*R3*	*R4*	*R5*	*R6*		
1.	Increased cost of production	15	19	21	26	125	34	42.03	V
2.	High wage rates of labour at peak harvest times	11	24	156	20	13	16	52.30	III
3.	Disruptions in post-harvest management of farm produce	12	23	28	32	39	106	38.49	VI
4.	Shortage of labour	190	12	14	11	7	6	71.02	I
5.	Limitations in the availability of agricultural inputs	13	178	19	15	8	7	59.95	II
6.	Delay in harvesting and loss of yield	18	11	17	145	29	20	46.66	IV

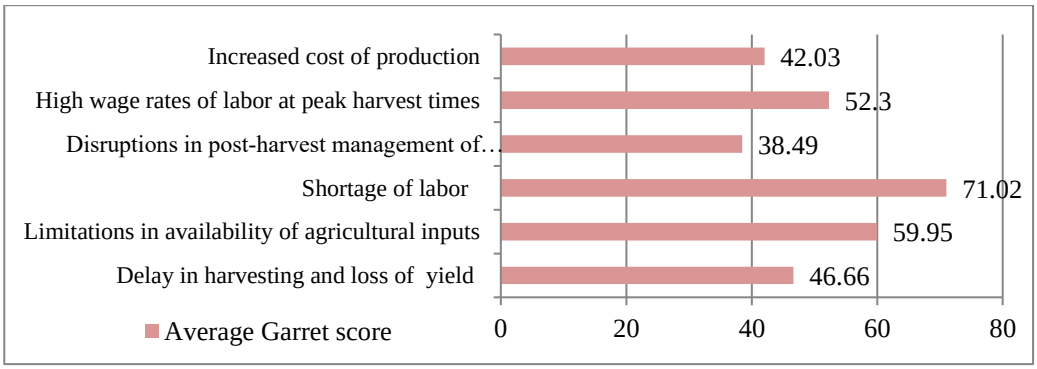

Figure 4: Production Constraints Impacting Vegetable Growers

Among the constraints from figure 4, shortage of labour is the most significant production constraint faced by the vegetable growers with an average garret score of 71.02 and ranked-I. This may be due to the movement restrictions across the nation due to the lockdown and shutdown, followed by limitations in the availability of agricultural inputs with an average garret score of 59.95 being ranked-II and high wage rates of labour at peak harvest times with an average garret score of 52.30 being ranked-III in the order of priority respectively. Delay in harvesting and loss of yield being ranked IV, increased cost of production ranked V and disruptions in post-harvest management of farm produce with a rank of VI are the least significant production constraints with average garret scores of 46.66, 42.03 and 38.49 respectively. These constraints disrupted key aspects of the agricultural operations affecting every stage of the agricultural cycle starting from planting to harvesting. It had resulted in loss of yields, lower quality of

produce and incurred financial loss to the vegetable growers. This may be due to the restrictions imposed by the government resulting in uneven demand and supply of essential commodities leading to drastic changes in price and severely affecting the production activities of vegetable growers. These results are supported by Harris *et al*. (2020) and NABARD (2020).

Technological Constraints

Technological constraints affecting vegetable growers are presented in table 5.

Table 5: Distribution of Respondents according to the Technological Constraints

Sl.No.	*Constraints*	*Rank given by the vegetable growers*						*Average Garret score*	*Rank*
		R1	*R2*	*R3*	*R4*	*R5*	*R6*		
1.	Lack of proper guidance and assistance for the farmers	19	176	14	12	8	11	60.03	II
2.	Lack of adequate infrastructural facilities	8	17	21	28	132	34	40.72	V
3.	Limitations in farm and market information	10	13	15	149	23	30	44.97	IV
4.	Lack of skill in various farming and non-farming activities	14	22	29	34	37	104	38.97	VI
5.	Inadequate knowledge and awareness on COVID-19 pandemic	183	17	15	10	6	9	70.25	I
6.	Lack of adequate extension support and other institutional technical services	12	21	164	19	16	8	53.13	III

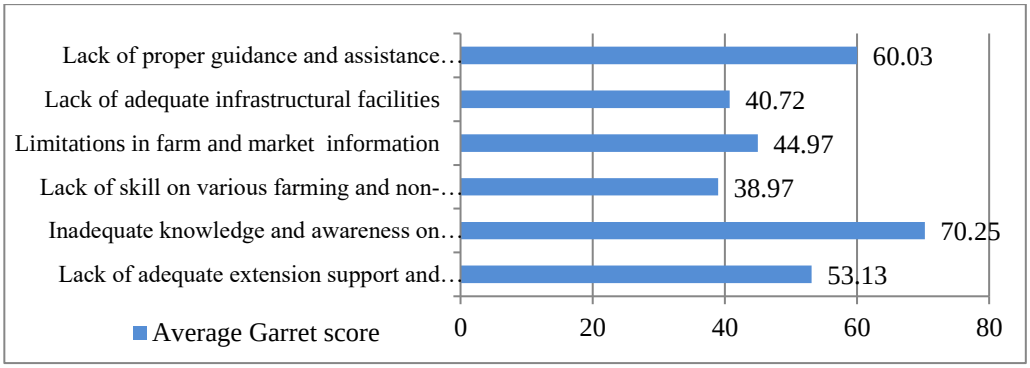

Figure 5: Technological Constraints Impacting Vegetable Growers

From figure 5, results revealed that inadequate knowledge and awareness of the COVID-19 pandemic is a critical technological constraint affecting vegetable growers with an average garret score of 70.25, ranked first. This may be due to a lack of adequate exposure to the various information sources, which influenced their mindset. The second most significant constraint was the lack of proper guidance and assistance for the farmers with an average garret score of 60.03, ranked second. This was followed by insufficient extension support and other institutional technical services, which ranked third with an average score of 53.13. Limitations in farm and market information were ranked fourth

with a score of 44.97, lack of adequate infrastructural facilities ranked fifth with a score of 40.72 and lack of skill on various farming and non-farming activities ranked sixth as the least critical technological constraint with an average garret score 38.97. It had a multifaceted impact on the efficiency of the vegetable growers affecting the resilience of vegetable farming systems. These challenges were likely exacerbated by inefficient implementation of the initiatives and inadequate support provided during the pandemic, further impacting the productivity and sustainability of vegetable growers.

Marketing Constraints

The marketing constraints are outlined in Table 6. From Figure 6, it can be concluded that the lack of transportation facilities due to mobility restrictions is the most critical issue affecting vegetable growers, with an average Garrett score of 72.07, ranked first. This is primarily attributed to the nationwide lockdown implemented to curb the spread of the virus. The second most significant constraint is the inaccessibility to marketing facilities, with an average Garrett score of 59.45, ranked second. This is followed by the restricted movement of farm produce, ranked third with a score of 51.86. Additional challenges include the perishable nature of farm produce, ranked fourth with a score of 46.23, changes in the demand and supply of farm produce, ranked fifth with a score of 42.35, and high price fluctuations resulting in distressed sales, which ranked sixth and is considered the least critical marketing constraint with an average Garrett score of 39.03. These constraints affected the ability of the farm produce to reach consumers and their effective distribution for ensuring consistent income for the vegetable growers. The challenges of the traditional market practices compounded the difficulties faced by vegetable farmers. These issues were largely driven by border closures and transportation restrictions during the lockdown, which significantly disrupted the supply chain and negatively impacted vegetable growers. These findings partially align with the study by Ragasa *et al*. (2021), highlighting similar challenges faced by agricultural producers during the pandemic.

Table 6: Distribution of Respondents according to the Marketing Constraints

Sl.No.	*Constraints*	*Rank given by the vegetable growers*						*Average Garret score*	*Rank*
		R1	*R2*	*R3*	*R4*	*R5*	*R6*		
1.	Restricted movement of farm produce	16	21	144	19	23	17	51.86	III
2.	The perishable nature of the farm produce	11	18	32	130	20	29	46.23	IV
3.	Lack of transportation facilities due to mobility restrictions	199	13	10	7	3	8	72.07	I
4.	High price fluctuations resulting in a distress sale	16	19	24	37	45	99	39.03	VI
5.	Inaccessibility to marketing facilities	11	185	19	4	7	14	59.45	II
6.	Change in demand and supply of the farm produce	14	21	26	30	111	38	42.35	V

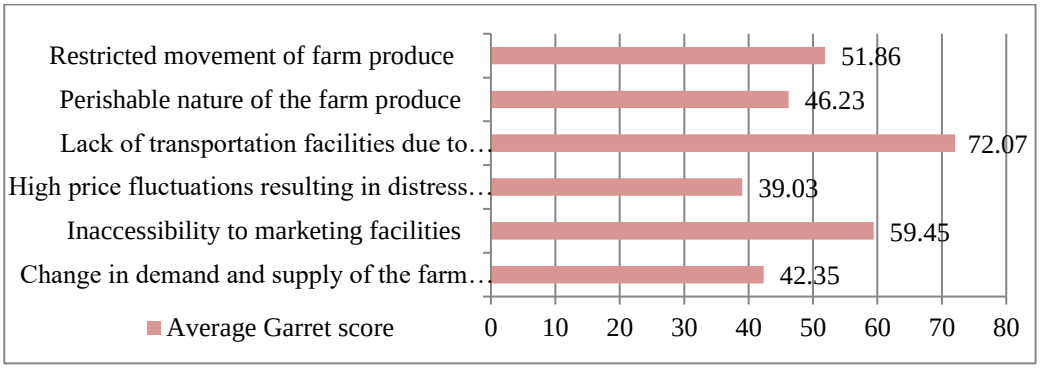

Figure 6: Marketing Constraints Impacting Vegetable Growers

Conclusion

The COVID-19 pandemic caused severe disruptions to the supply chains of perishable farm produce, particularly vegetables, which require rapid distribution and marketing to prevent spoilage. The outbreak led to significant deterioration of perishable goods, resulting in substantial losses for vegetable growers. The findings of the study revealed the fear of COVID infection, fear of socialization and fear of loss of livelihood as the primary psychological constraints followed by restrictions on movement and social gatherings due to lockdown, low social or personal interactions and social distancing and quarantine protocols as the major social constraints, high cost of labor and agricultural inputs, inaccessibility to credit and banking facilities and low cost of the farm produce in the market as the critical economic constraints, shortage of labor, limitations in availability of agricultural inputs and high wage rates of labor at peak harvest times as the indicative production constraints, inadequate knowledge and awareness on COVID-19 pandemic, lack of proper guidance and assistance for the farmers and lack of adequate extension support and other institutional technical services as important technological constraints whereas, lack of transportation facilities due to mobility restrictions, inaccessibility to marketing facilities, restricted movement of farm produce as evident marketing constraints faced by the vegetable growers. The findings of the research reveal numerous significant challenges faced by vegetable growers adversely impacting their production, marketing and financial sustainability. Thus, it is crucial to derive actionable strategies such as strengthening agri-value chains, improving financial accessibility, promoting sustainable agricultural practices and adopting new technology to enhance the resilience of vegetable growers. Further, focusing on these areas through targeted research ensures long-term holistic growth and development. The stress on vegetable growers during the pandemic highlights the importance of developing resilient agricultural practices by providing valuable insights into developing policies and strategies for enhancing agricultural sustainability that can better withstand future global crises.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	Author 1	Author 2
Conceived and designed the research or analysis	Yes	Yes
Collected the data	Yes	No
Contributed to data analysis & interpretation	Yes	Yes
Wrote the article/paper	Yes	Yes
Critical revision of the article/paper	Yes	Yes
Editing of the article/paper	Yes	No
Supervision	No	Yes
Project Administration	Yes	Yes
Funding Acquisition	No	No
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The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

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